



# **Armed Forces College of Medicine AFCM**



## Control of Renal Blood Flow

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# INTENDED LEARNING OBJECTIVES (ILO)



By the end of this lecture the student will be able to:

1. State the normal blood flow .
2. Discuss the regional blood flow and O<sub>2</sub> consumption by the kidney .
3. Define filtration fraction.
4. Explain autoregulation of RBF and GFR and the blood pressure range at which it is effective.
5. Compare the different intrinsic mechanisms that regulate RBF and GFR.
6. Discuss the nervous ( sympathetic ) control of RBF and GFR .
7. Distinguish between the hormonal and paracrine control of RBF and GFR .

# Renal blood flow

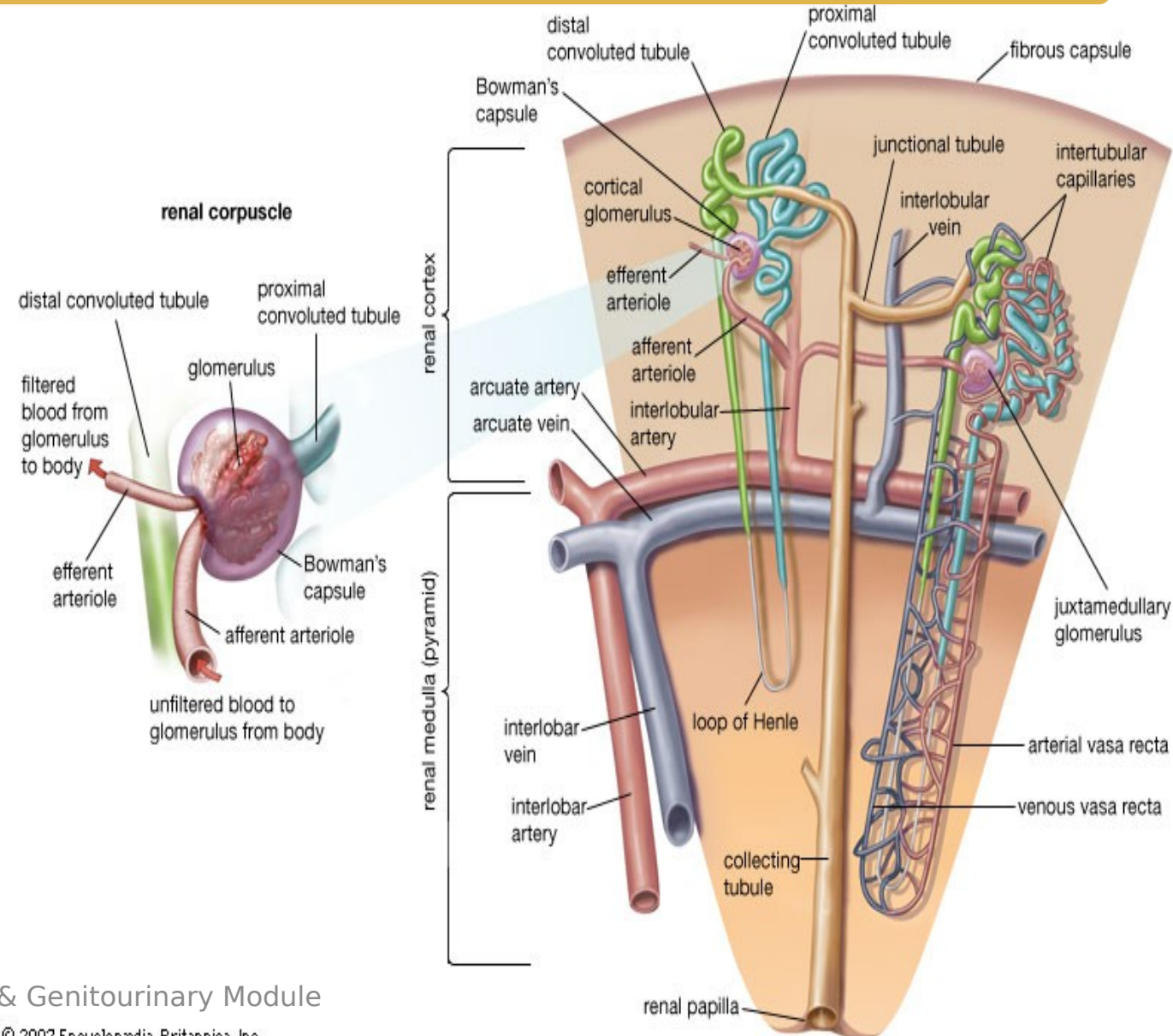


In a resting adult, the kidneys receive 1.2-1.3 liter of blood per minute, i.e. 21% of the cardiac output.

# Renal Vascular Arrangement



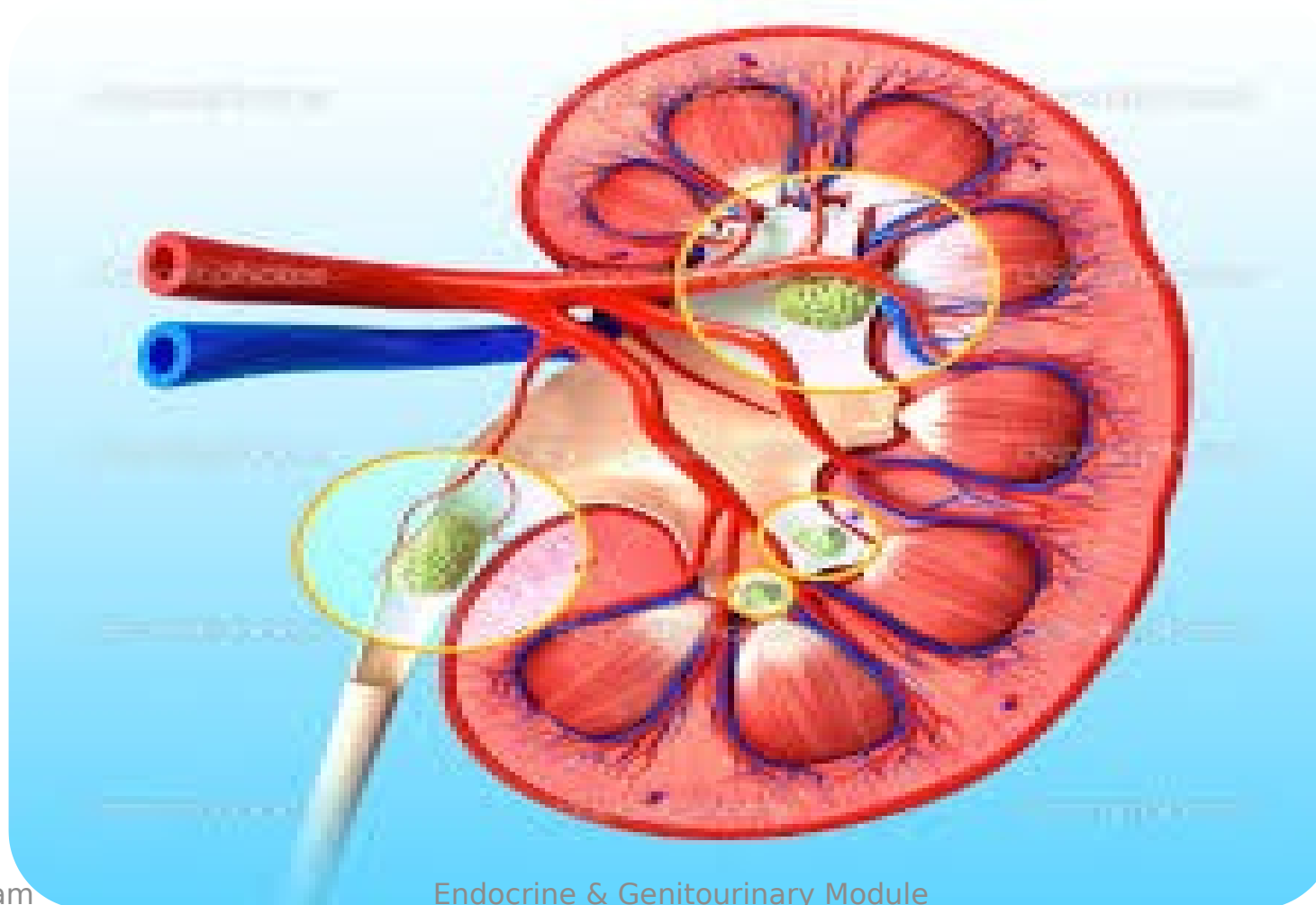
- The renal arteries are direct branches of the aorta.
- Each renal artery on entering hilum of the kidney divides to form the interlobar arteries, arcuate arteries and intratubular arteries.



# Renal Vascular Arrangement



- The afferent arterioles arise from the interlobular arteries.



# Renal Vascular Arrangement



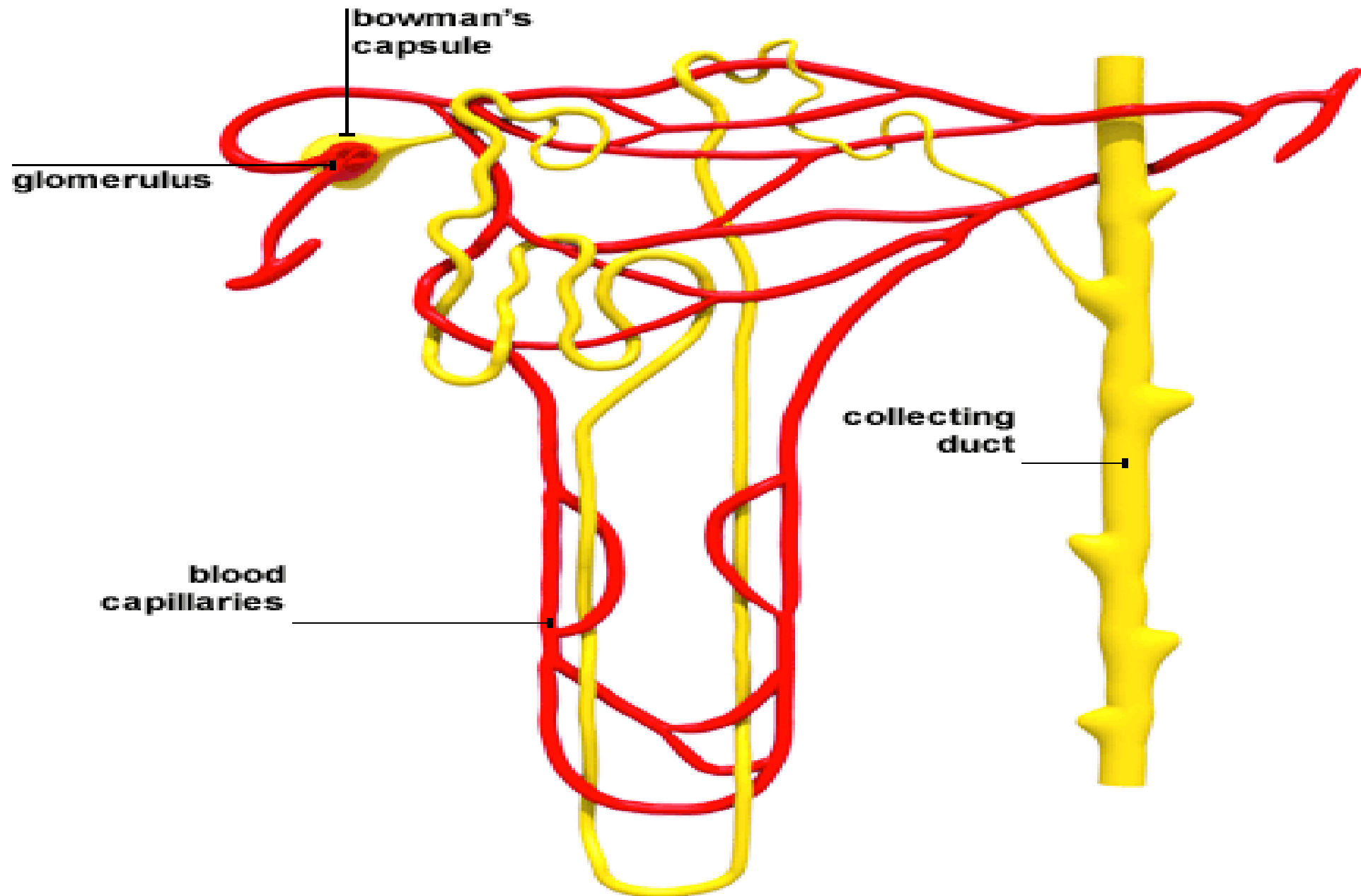
- Each arteriole divides into glomerular capillaries .
- The capillaries reunite to form the efferent arteriole, which in turn breaks up into the peritubular capillaries that supply the tubule.

# Renal Vascular Arrangement



- The capillaries draining the tubules of the cortical nephrons form a peritubular network, whereas the efferent arterioles from the juxtamedullary nephrons drain not only into peritubular network, but also into the vasa recta which are hairpin capillary loops that lie side by side with the loops of Henle.
- The peritubular capillaries reunite to form interlobular veins → arcuate veins → interlobar veins → renal veins.





# Renal Vascular Arrangement



Therefore, there are two capillary beds associated with each nephron:

## **1) The glomerular capillary bed: "High pressure bed"**

- It receives its blood from the afferent arteriole.
- The hydrostatic pressure in the glomerular capillaries is about 60 mmHg which cause rapid filtration of fluid.
- The pressure in the glomerular capillaries is higher than in other capillary beds due to:
  - a) The renal arteries are direct branches of the abdominal aorta.
  - b) The afferent arterioles are short, straight branches of the interlobular arteries.
  - c) The efferent arterioles have high resistance than the afferent arteriole.

## **2) The peritubular capillary bed "Low pressure bed"**

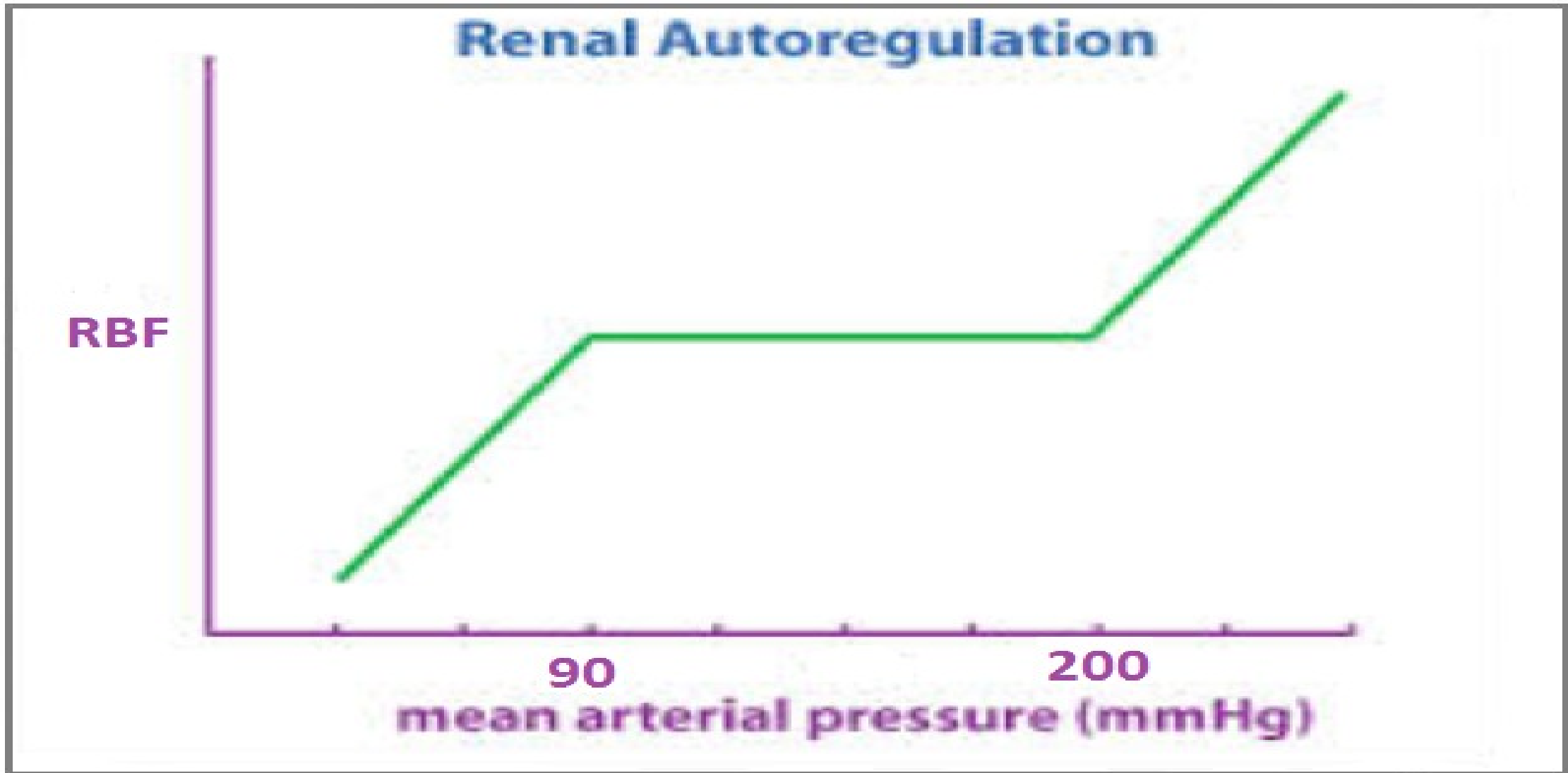
- The hydrostatic pressure is about 13 mmHg. The peritubular capillaries behave like the venous ends of other capillaries. The low pressure in these capillaries permits fluid reabsorption from the interstitium into the blood.

# Regional Blood Flow



- The renal cortex receives most of the renal blood flow (98%).
- This helps filtration of large volumes of plasma through the glomeruli that lie in the cortex.
- The renal medullary blood flow accounts for 2 % of the total renal blood flow.
- This sluggish blood flow in the renal medulla allows the kidney to form concentrated urine.

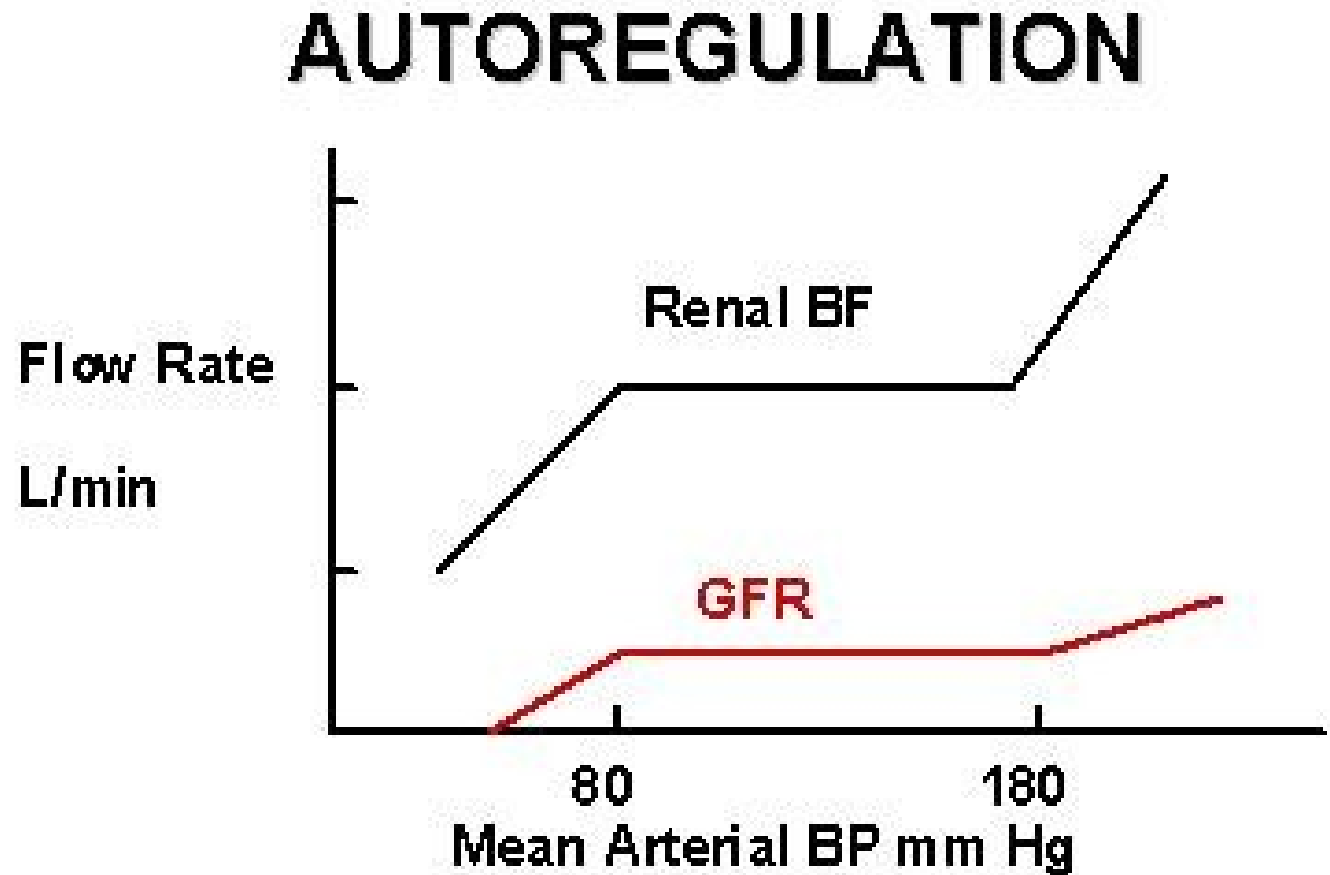
# Auto-regulation of the renal blood flow



# Aim of auto-regulation



The major function of auto-regulation of RBF is to keep constant glomerular filtration rate and to allow precise control of renal excretion of water waste products and salts



# Mechanisms of autoregulation of renal blood flow



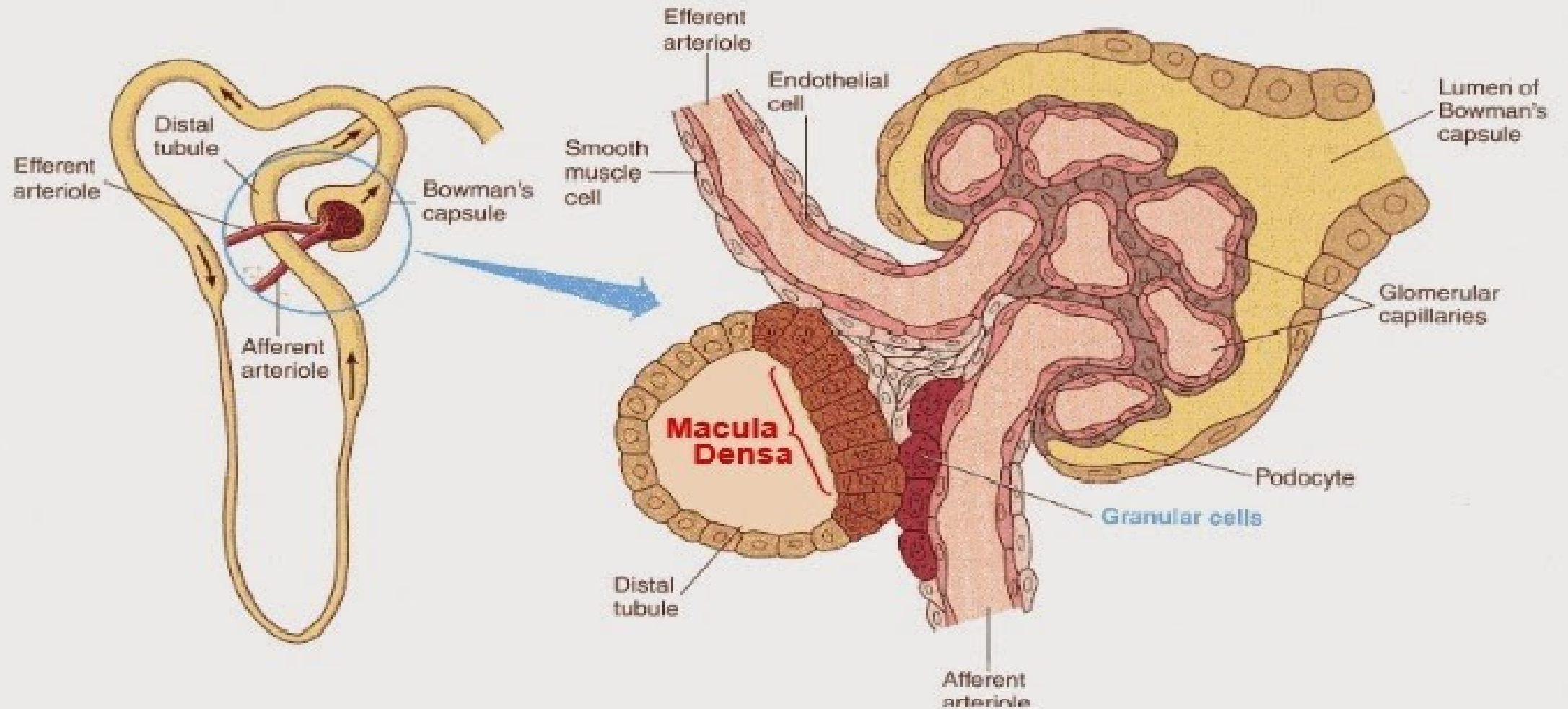
## 1-Myogenic Mechanism:

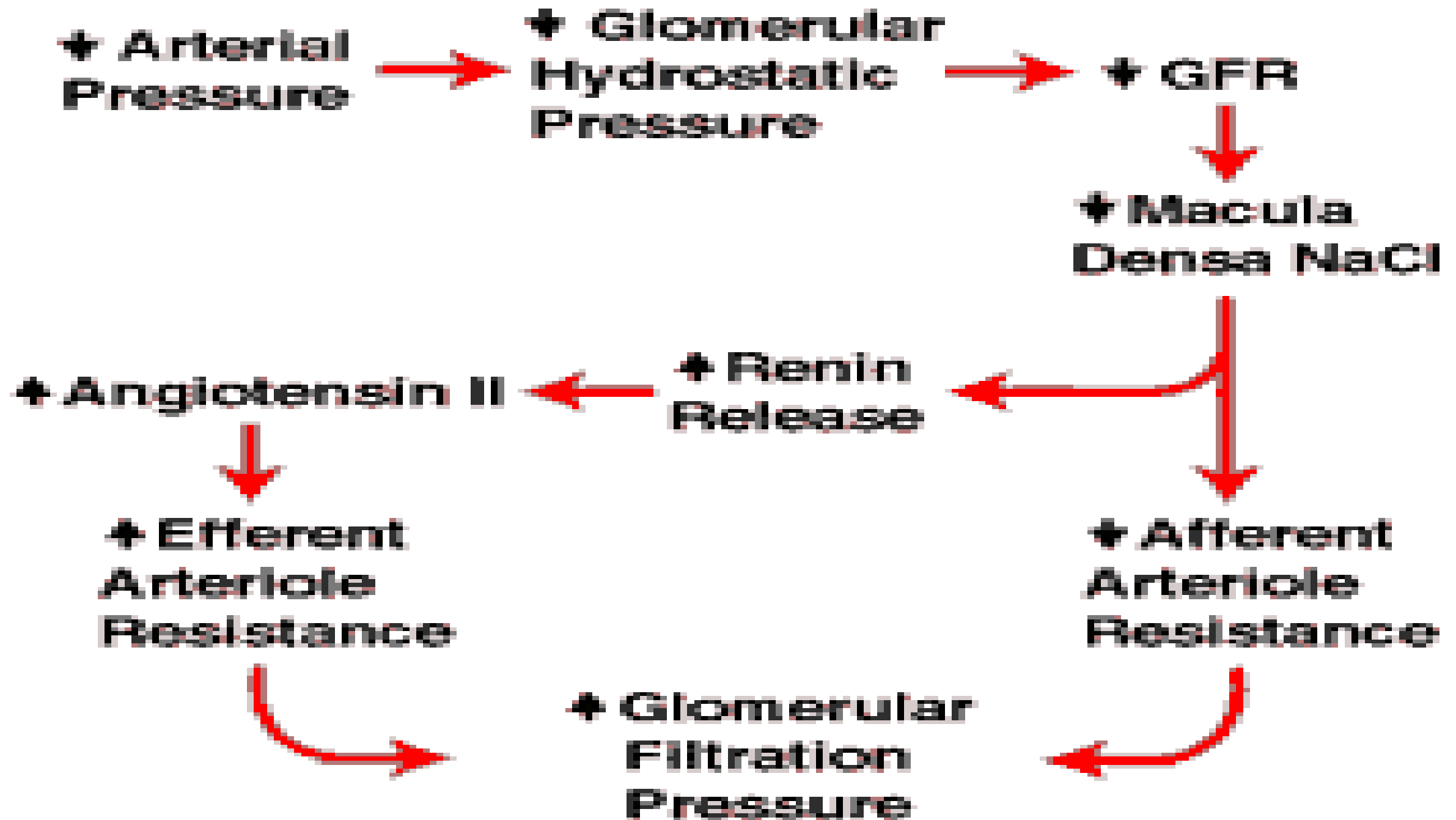
- A -With rise of pressure VC of afferent arterioles.
- B- With drop of pressure VD of afferent arteriole.

## 2- Tubulo-glomerular balance feed- :

# Tubuloglomerular Feedback

## Juxtaglomerular Apparatus (JGA)







# Innervation of the renal vessels and the renal tubule



## Sympathetic fibers supply:

### 1) Renal vessels

Sympathetic stimulation produces vasoconstriction with decrease in renal blood flow and glomerular filtration rate (mediated by  $\alpha$  - adrenergic receptor). This occurs during exercise and rising from the supine to the standing position and when the systemic blood pressure fall.

# Innervation of the renal vessels and the renal tubule

## 2) Juxtaglomerular apparatus:

Sympathetic stimulation increases renin secretion by juxtaglomerular cells (mediated by  $\beta_1$  adrenergic receptors).

## 3) Renal Tubule:

Sympathetic stimulation increases Sodium reabsorption by the tubular cells . It is mediated via  $\alpha$  - or  $\beta$  - adrenergic receptors and it may be mediated by both.



## **Question 1**

**Which of the following is the function of the tubulo-glomerular feedback ?**

- a) Increase solute reabsorption by increasing GFR
- b) Adjustment of RBF and GFR
- c) Regulation of Na reabsorption
- d) Release of renin from the macula densa
- e) Regulation of H<sub>2</sub>O reabsorption by the Loop of Henle



## Question 2

**Renal blood flow (RBF) is :**

- a) 10 % of cardiac output
- b) Doubled when mean arterial pressure rises from normal value of 90mmHg to 150 mmHg
- c) Distributed equally between the cortex and medulla
- d) Regulated by vagus nerve
- e) Auto - regulated by tubul - glomerular feedback mechanism

## SUGGESTED TEXTBOOKS



1. Ganong's Review of Medical Physiology 25<sup>th</sup> Edition from page 674 to 676.
2. TEXTBOOK OF Medical Physiology 11<sup>th</sup> Edition GUYTON and HALL from page 320 to 325.

Thank You

